GROUP-FLASHING LIGHTS.

[*Pamphlet first published in October*, 1874.]

EXTENSION of trade, and the consequent increase in the number of Lighthouses upon frequented coasts, continually causes a demand for greater variety in the appearance of Lights, in order to avoid confusion from the nearness of Lights of the same character. This is apparent in the fact that the scheme proposed by the first French Lighthouse Commission, and intended to be complete, has subsequently required extension. The first French scheme admitted but three distinctions, the fixed Light, and revolving Lights with flashes every minute and every thirty seconds. Now, the French system comprises quick-flashing Lights, revolving Lights with red flashes alternating with white, and fixed Lights varied by flashes; of the last there are no less than twenty-three on the French coast. Indeed the use of red at all in revolving Lights, involving as it does a serious tax on the luminous power of the flashes, or increased expense for the same power, sufficiently indicates that new combinations are, and will continue to be required. Our present purpose is to offer in a complete shape two new forms of Lighthouse apparatus, and to point out the advantages they possess over some very useful forms now in use. Before doing so it will be well to examine what are the qualities of a good Light. That for any given cost the intensity of the light should be as great as possible, or conversely, that when a given intensity of light is required it should be attained at a minimum expense, is obvious. Most distinctions of beacons depend on the succession of intervals of light and darkness.

The following are suggested as rules of comparison of the efficiency of such distinctions :—

1. The Light must not be too long obscured or an accident might occur in the interval, which a sight of the Light would have prevented. What period of darkness is admissible is a nautical question, and will depend on the position the Lighthouse occupies and the nature of the traffic which it has to guide. Flashes at intervals of as much as three minutes have been in use, but the tendency is to prefer shorter periods, as in the case of South Stack, which is to be altered from flashes every two minutes to flashes every minute. We may therefore assert that, other things being the same, the efficiency is increased as the time of eclipse is shortened.

2. Unless the eclipse is very short it is necessary that the duration of the flash should be sufficient to take the bearing of the Light. It is this among other reasons which necessitates a special form of revolving dioptric apparatus for condensing the electric light; with the usual form for oil flames, the flash of a half-minute electric light would last but the fraction of a second. What time is sufficient for taking a bearing, is again a purely nautical question, but we may safely say that a flash of considerable duration is more useful than one which gives bare time for observation.

3. The character of the Light must not be too long in declaring itself, in other words the Light must pass through its phases in a reasonable period of time, indeed the shorter this period the better. The fixed and flashing Lights of the French system are usually characterised by a bright flash, preceded and followed by a very brief eclipse, occurring every three or four minutes; not less than that period of watching is needed to identify the Light. It is a question for those whose experience justifies an expression of opinion, whether in some circumstances such a length of time is not too much. In this respect the revolving Lights with red and white flashes combined, are less favourable than the ordinary revolving Lights of the same period; for example, to distinguish a half-minute revolving Light showing red and white flashes alternately, from one in which there is a red followed by two whites, requires a minute and a half. Suppose the navigator first sees a white flash, then a red and again a

white, a minute has passed and he must still wait thirty seconds to see if the next flash will be white or red. It should, however, be observed that this remark only applies to the hypothetical case in which two such Lights are placed near each other.

4. One point insisted upon by Authorities who have themselves had nautical experience is, that the distinctions should be as simple and easy to apprehend as possible. It is mainly on this account that the scheme proposed by Mr Babbage never received any practical recognition. For the same reason it is unwise to trust too much to any but very marked differences in the period of ordinary revolving Lights. A forty-five second should not be considered safely distinguishable from a minute flash.

5. The characteristic appearance of the Light must be maintained at all distances and in all states of the weather in which the Light can be seen at all. If red and white flashes are combined, the portion of light devoted to each flash must be such that they shall have equal penetrating power. It would appear that the fixed and flashing Lights so popular on the French coast, would lead to mistakes at times when the feeble fixed Light is obscured, if the intervals of the flashes were not so long as to distinguish them from the ordinary revolving Lights.

The additional source of variation which I now propose is, that revolving apparatus should be constructed to exhibit two or three white flashes in rapid succession, in place of one at stated intervals of time. This would increase the capacity for variation of the revolving Lights three-fold, we should have single, double and triple flashes at whatever intervals are now considered suitable for revolving Lights. The optical apparatus for producing such combinations would be simple and cost little more than an ordinary revolving Light. For the double flash of the first order we should require a twelve-sided Light, the axes of the panels being placed at unequal intervals, alternately 15° and 45° (Fig. A.); the effect of this would be, that, with an apparatus completing a revolution in three minutes, and using as source of light the usual four-wick flame, there would be a flash of about 2″ duration followed by about $5\frac{1}{2}$″ dark, again a flash of 2″, this double flash being separated from the next by about $20\frac{1}{2}$ seconds of darkness. The ordinary eight-sided revolving Light condenses 45° of the light of the flame into about 4° in azimuth, thus producing a flash

of intensity $11\frac{1}{4}$, if the continuous light of the fixed apparatus be taken as unity. In the double flashing Light each panel has 30° in azimuth, and would therefore give to each flash an intensity represented by $7\frac{1}{2}$. Let us see how far this form of Light fulfils the requirements of a good Light. With periods of half a minute the longest eclipse would be $20\frac{1}{2}$ seconds, giving a slight advantage over a half-minute Light with eight sides, which is eclipsed for about 27 seconds. The two flashes near to each other would be almost as convenient for taking a bearing as a continuous flash lasting from the beginning of the first flash to the end of the second; we may therefore consider that we have $9\frac{1}{2}$ seconds available to take a bearing. It would only be necessary to see the two flashes in succession to identify the character of the Light, $9\frac{1}{2}$ seconds would suffice without any counting to

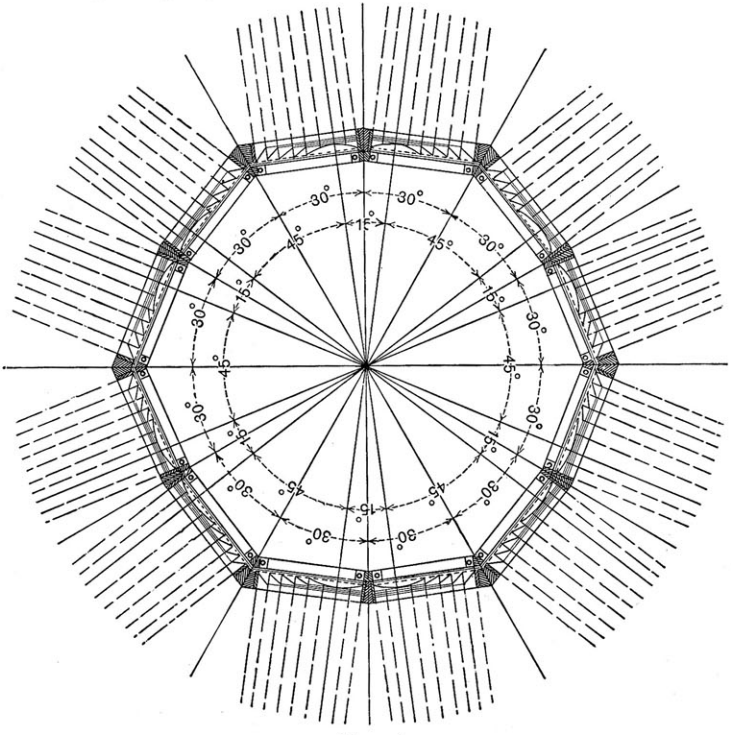

FIG. A.

recognise what the Light might be. The peculiarity of such a Light would lie, not in the precise periods between the flashes, but in the flash being a double one. No timing or counting is

requisite, for the double and triple flash would be distinguished without any conscious process of counting. The two flashes of the pair being exactly of the same power, the general appearance of the Light must be always the same.

The triple flash would be conveniently obtained by a revolving apparatus of fifteen sides covering 24 each, the axes of the panels being placed at intervals of 48° and 12°. From such an apparatus, if a group of three flashes is to be exhibited every half-minute, each flash would last nearly two seconds, and the three would be separated by dark periods of three seconds. We should thus have a longest period of darkness of eighteen seconds, and twelve seconds in which to take a bearing. An apparatus giving four flashes in a group could be readily and economically formed of sixteen sides, there would not be the slightest difficulty in construction, and the flash would be of the same power as that of an ordinary sixteen-sided revolving Light. But it is doubtful if the need for counting so many as four flashes would not be found an unnecessary complication. All I would say here is that such a Light can easily be made.

The electric spark lends itself more readily than an oil flame to the production of any desired arrangement of the flashes of a revolving Light. Perhaps as unmistakable a form as any that could be suggested, would be a number of very quick flashes and eclipses, constituting a group which should recur at stated intervals.

It is worthy of notice that if a coast were lit on a system based on the use of group flashes, the appearance of the Light could be made to correspond to the blasts of the fog-horn or the strokes of the fog-bell; a group of three flashes, at intervals of thirty seconds, would naturally be used in conjunction with a fog-signal, sounded three times in succession at the same interval.

The following Table is intended to show the comparative advantages and disadvantages of group flashes, and the best forms of revolving Lights now in use. In this table the flashes or groups of flashes are supposed to have a half-minute period, the apparatus to be of the first order, and the divergence due to magnitude of flame to be 4°. The first column gives the power of the flash, the fixed Light being taken as unity.

	Power.	Time available for taking a bearing.	Time which may be required to identify the character of Light.	Greatest duration of darkness.	Percentage of whole Light wasted by use of colour.
Eight-sided revolving Light, of the usual form	$11\frac{1}{4}$	$2\frac{2}{3}$ Seconds.	30 Seconds.	$27\frac{1}{3}$	——
Sixteen-sided ditto	$5\frac{5}{8}$	$5\frac{1}{3}$,,	30 ,,	$24\frac{2}{3}$	——
Twelve-sided Light, giving a double flash	$7\frac{1}{2}$	$9\frac{1}{2}$,,	10 ,,	$20\frac{1}{2}$	——
Fifteen-sided Light, giving a triple flash	6	12 ,,	12 ,,	18	——
Nine-sided Light, giving a red flash, followed by two white.....	$6\frac{1}{3}$	3 ,,	90 ,,	27	36·84
Sixteen-sided Light, giving white and red alternate...	3	$5\frac{1}{3}$,,	90 ,,	$24\frac{1}{3}$	46·66
Eight-sided Light, red only...	$4\frac{1}{11}$	$2\frac{2}{3}$,,	30 ,,	$27\frac{1}{3}$	63·66
Sixteen-sided Light, red only	$2\frac{1}{22}$	$5\frac{1}{3}$,,	30 ,,	$24\frac{2}{3}$	63·66

It will be observed that in power, the double flash ranks second; in duration the group flashes are best, as also in respect to time required for identification.

Group-Flashing Lights can readily be obtained on the Catoptric system, or by using a number of small Holophotes, but such Lights would be subject to all the objections to which revolving Lights with single flashes produced by many lamps are obnoxious.

NOTE.—The Hopkinson Group-Flashing system was for the first time applied, in 1875, to the Catoptric Floating Light on the Royal Sovereign Shoals, near Beachy Head, and has since been applied to several Lightships of the Trinity Corporation.

The first Land Light on this system was for Tampico Lighthouse, Gulf of Mexico, Second Order triple-flashing, in 1875. Eighteen Sea Lights in all, and two Harbour Lights, have been constructed by Messrs Chance Brothers and Co., Limited, since 1875.

The Group-Flashing system has also been adopted by the French makers, who have, since 1876, supplied many lights to foreign Governments.

December, 1890.